Referee report

LOAC: a small aerosol optical counter/sizer for ground-based and balloon measurements of the size distribution and nature of atmospheric particles: 2. First results from balloon and unmanned aerial vehicle flights

J-B. Renard, F. Dulac, G. Berthet, T. Lurton, D. Vignelles, F. Jégou, T. Tonnelier, C. Thaury, M. Jeannot, B. Couté, R. Akiki, N. Verdier, M. Mallet, F. Gendarmes, P. Charpentier, S. Mesmin, V. Duverger, J.-C. Dupont, T. Elias, V. Crenn, J. Sciare, J. Giacomoni, M. Gotti, E. Hamonou, H. Olafsson, P. Dagsson-Waldhauserova, C. Camy-Peyret, C. Mazel, T. Décamps, M. Piringer, J. Surcin and D. Daugeron

General comments:

As first sight, this paper gives the impression that it only brings very limited amount of new results from experiments of which part of them are already described in Paper 1. Many repetitions of information contained in Paper 1 let rise questions about the usefulness of this article. The authors don't hesitate to use copy/paste, what is particularly irritating, distracting and not really respectful for the reader who might spend his/her time in a more useful way. The quality of the text should definitely follow more closely the standards of a quality scientific journal.

All these repetitions occupy about a third of the length of the paper, which is, taking account the need to read Paper 1 to have an overview of the LOAC principle, much too long. Most of the photographs bring, in my opinion, very few real added value, if any. The one in Figure 1 could be useful but, unfortunately, no element gives any idea of the real dimension, missing an important part of its usefulness.

Section 2 also brings very few new elements in the description of the instrument.

In Section 3, the report given about measurements at "Observatoire Atmosphérique Generali" includes once again repetition of informative background from Paper 1, again sometimes just "copied-pasted" from it. Results from this campaign are spread over Paper 1 and 2, while a synthesis of them would make them much more readable, interesting and pertinent for such a review of the LOAC project.

Concerning the scientific approach, its looks like the only objective pursued by the authors is to show that "it flies and seems to work in all conditions". A detailed analysis of the data is never really provided. There is no attempt to validate seriously the results, nor even to try, if reference data are really missing, to investigate the effect of changing experimental conditions (e.g. different weather conditions for a same location) on the measurements. An important test would be to see the impact of the choice of inlet on the response, e.g. on the detection of large particles. But this can't be assessed from this work, and the choice of inlet is even not always provided.

I also regret the poor quality of the manuscript, which seems written very fast and still presents many typos.

Specific comments:

Abstract

- Remarks given in the review of Paper 1 should be taken into account, more particularly remarks about the expected limitations and real performances over the size range targetted by LOAC.

2. LOAC instrument and gondola for balloon flights

- L. 19 p.10061: Concerning the estimate of the uncertainties, see comments in the referee review of Paper 1.
- L. 4 p.10062: Inconsistency with Paper 1, where a weight of 350 g is mentioned.

3.1 General comments

- L. 6 p.10063: What do the authors mean by: "the aerosols were rejected inside the gondola"? One should expect that aerosol are rejected "outside" to avoid the creation of a pollution cloud.

3.2 Unmanned Aerial Vehicle flights

- This campaign is not indicated in Table 1, and there is no mention of the kind of inlet used for this campaign.

3.3 Tethered balloons

- Campaign in Vienna: The authors just give some profile of vertical size distribution (Figure 5) with an analysis of the aerosol topology. However, a lot of efforts were made to improve the air quality in Vienna, and this city disposes on a dense air quality measurement network, monitoring continuously the air of the city. Hence, I guess that a lot of data are available to validate LOAC's measurements, or at least to make some first intercomparison between size distributions measured in the city. Why isn't it done?
- Figure 4: I am not sure that all these pictures really bring significant additional information to the discussion.
- Campaign OAG: This long-duration campaign provides most probably enough data to illustrate all what is mentioned in the text. The authors could show the contamination due to construction activities, the difference between size distributions (as a function of the size) at ground level and at some selected interesting altitudes, during events of well-mixed air and during pollution events. Episode with a visible accumulation layer could be shown with the temperature profile to visualize the temperature inversion and the effect on the layer. The authors, clearly, miss many opportunities of interesting discussions, and again, no validation is proposed using local air quality measurements.

  It is interesting to note that no particles are detected with a size higher than 20 µm. Could it be due to the characteristics of the TSP inlet (See referee report on Paper 1, comment on L. 27-28 p.10010, L. 12-13 p.10011)?
- L. 2-3 p.10066 and Figure 9: In the upper panel, the part of the "speciation index curve" included in the "Mineral" region includes mainly particles in the 0.2-0.8 µm

diameter range. As seen in Paper 1 (cf. my comments on the paper and e.g. comments on Figure 4), LOAC seems very insensitive in this size range, so that the behaviour of the "speciation index curve", which shows an outlier behaviour in almost all illustrated cases, including the ones in Paper 1. Further, as mentioned by the authors in Paper 1, detection of mixed aerosol types using this "speciation index" method is inherently particularly hazardous. Consequently, the interpretation in terms of "mineral aerosols" is very uncertain, what should be mentioned. See also my comments on Figures 18-22 in Paper 1.

3.4 ChArMEx tropospheric flights

- Figure 11 and 12: The very different layout and positioning of both figures make them not very clear. The authors should limit the picture in Figure 12 to the same geographic area as in Figure 11, and indicate the balloon trajectory on the figure. Figure 11 can then be removed.

3.5 Upper tropospheric and stratospheric flights

- The feature between 5.5 km and 8 km in Figure 15 is unclear: is there any measurement in this altitude range? If yes, why did particles higher than 0.7 µm disappear? And if no, which kind of information was used by the authors to claim that the sand plume was up to 7 km?
- L. 10-14 p.10069: This is a kind of « take-and-carry » statement! The cited papers report various different campaigns taking place at totally different times and locations. Hence, "Good agreement" should be replaced at best by something like "plausible following results of stratospheric campaigns performed by…". Looking more closely at the granulometry, LOAC's measurements show in the stratosphere a quite high amount of particles of size ~1 to 5 µm, which is absolutely not found in Deshler's measurements [See Deshler et al., 2003 but also Kovilakam and Deshler, J. Geophys.Res., 2015 about corrected measurements from Wyoming].
- L. 21-24 p.10069: The profiles rather show a succession of pronounced 2-3 km thick layers with maxima decreasing slowly with increasing altitude, (about 1 orders of magnitude between the maximum peak situated at ~16 km and the highest altitude around 30 km). As a comparison, vertical profiles of background stratospheric aerosols shown in Figure 3b of Deshler, 2003 (cited by the authors) show a single peak around 11 km, and basically a monotonically decreasing concentration with increasing altitude above this peak. The ratio between concentrations at the peak and ~30 km height is about 4 orders of magnitude and, again, no particle larger than 1 µm is detected above 18 km with a concentration $\geq 10^{-3}$ cm^{-3}. In [Renard et al., Appl. Opt 2005, Fig. 6], vertical profiles measured above Aire sur l'Adour give similar concentrations for the various particle classes, but not such a strongly stratified structure through the whole vertical profile. Hence, I am not sure that Figure 17 illustrates a "typical example of background stratospheric aerosols".
- L. 12 p.10070: Again, the authors should be more precise in their quantification. The extinction ratio between values at the aerosol peak and 30 km can be of several orders of magnitude.

Technical corrections:

- L. 26 p.10050, L. 20 p.10064: incorrect word.

- L. 17-19 p.10061: meaningless sentence.
- L. 20 p.10064, L. 27 p.10065: incorrect units.
- L. 8-10 and 10-12 p.10069: sentence revision needed.
- Figure 11 and 12 could be cropped and reduced to the same scale to make the comparison easier and to save place.